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Two new localities of the endangered fish *Systomus martenstyni* (Kottelat & Pethiyagoda, 1991) (Teleostei: Cyprinidae) found in Sri Lanka

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Abstract: *Systomus martenstyni* is an endemic and endangered fish of Sri Lanka. This species was earlier known to be restricted to the Amban Ganga River basin. Recently two populations of *S. martenstyni* were located in two major tributaries of River Mahaweli: Loggal Oya and Badulu Oya in the Uva province of Sri Lanka. These new populations are relatively small and are facing the threat of habitat quality degradation and habitat loss. Effective conservation actions should be undertaken to conserve this endangered fish species.

Key words: new population, endemic, habitat degradation, River Mahaweli, Martenstyn's Barb

Sri Lanka is an island with rich freshwater fish diversity. In Sri Lanka four major ichthyological zones have been identified (Southwestern, Mahaweli, Dry and Transition) based on the distribution pattern of freshwater fishes (Goonathilake 2012). Out of these four zones, Southwestern and Mahaweli zones show the highest freshwater fish diversity in the island (Goonathilake 2012). Although the fishes of the Mahaweli zone are relatively well known, it continues to produce significant discoveries, despite widespread habitat destruction. Recently two populations of the Martenstyn's Barb, *Systomus martenstyni* (Kottelat & Pethiyagoda, 1991), were located in two major tributaries of river Mahaweli, Loggal Oya and Badulu Oya in the Uva province of Sri Lanka. Martenstyn's Barb was initially named as *Puntius martenstyni* (Pethiyagoda 1991). During the past two decades taxonomic nomenclature of freshwater fish was extensively revised and the genus *Puntius* was split into four genera namely *Puntius, Pethia, Systomus,* and *Dawkinsia* (Pethiyagoda et al. 2012). Thereafter Martenstyn's Barb was named as *Systomus martenstyni* (Pethiyagoda et al. 2012).

Systomus martenstyni was known as an endemic to a single river basin and was considered endangered (Goonathilake 2012). It was first described from the headwaters of the Amban Ganga a sub-basin of the Mahaweli (Pethiyagoda 1991). *Systomus martenstyni* has been recorded in the two principal tributaries of Amban Ganga, Kalu Ganga and Sudu Ganga, at elevations between about 150 m and 500 m, and it has not been recorded from anywhere else in Sri Lanka (Pethiyagoda 1991).

The two new localities of *S. martenstyni* were recorded during a study conducted in the downstream areas of Mahaweli River diversion scheme to study the impacts of river diversion on indigenous fishes of Sri Lanka. Fieldwork was conducted from December 2012 to January 2014. In this paper we present a detailed description of the two populations of *S. martenstyni* recorded from the two new localities.

Study sites were selected from the downstream area, between Rantambe and Manampitya. Study sites included two unregulated streams (Loggal Oya, 07°13′60″ N, 081°01′00″ E and Badulu Oya, 07°13′00″ N, 081°00′00″ E) and two regulated streams (Uma Oya, 07°12′00″″ N, 080°57′00″ E and Minipe, 07°13′00″ N, 080°58′60″ E). All the study sites were located in the dry zone with similar elevation levels ranging from 84 m to 131 m above mean sea level. The rainfall in the downstream areas is usually reliable only during October to January with a mean annual rainfall of 142.92 mm. Diurnal and annual temperatures vary little, with averages ranging from 25–35°C (Rusinow et al. 1993).

Different types of fish nets (cast nets, gill nets and pond nets) were used for sampling. Riffles and runs were sampled lower to upper direction of water flow where as pools were sampled in a downstream direction (Taylor

et al. 2006). Identification of the fish species was done using the taxonomic keys (Pethiyagoda 1999). Specimens collected during this study are deposited in the Wildlife Research Laboratory at the Department of Zoology, University of Peradeniya, Sri Lanka. Measurements were made with a digital Vernier caliper (Mitutoyo Absolute Digimatic Caliper 0-150mm / 0-6" Japan) and recorded to the nearest 0.01 mm (Pethiyagoda & Kottelat. 2005). A Principal Component Analysis (PCA) was carried out using Minitab 16.0 to compare the morphometric characters of specimens collected from the two new localities.

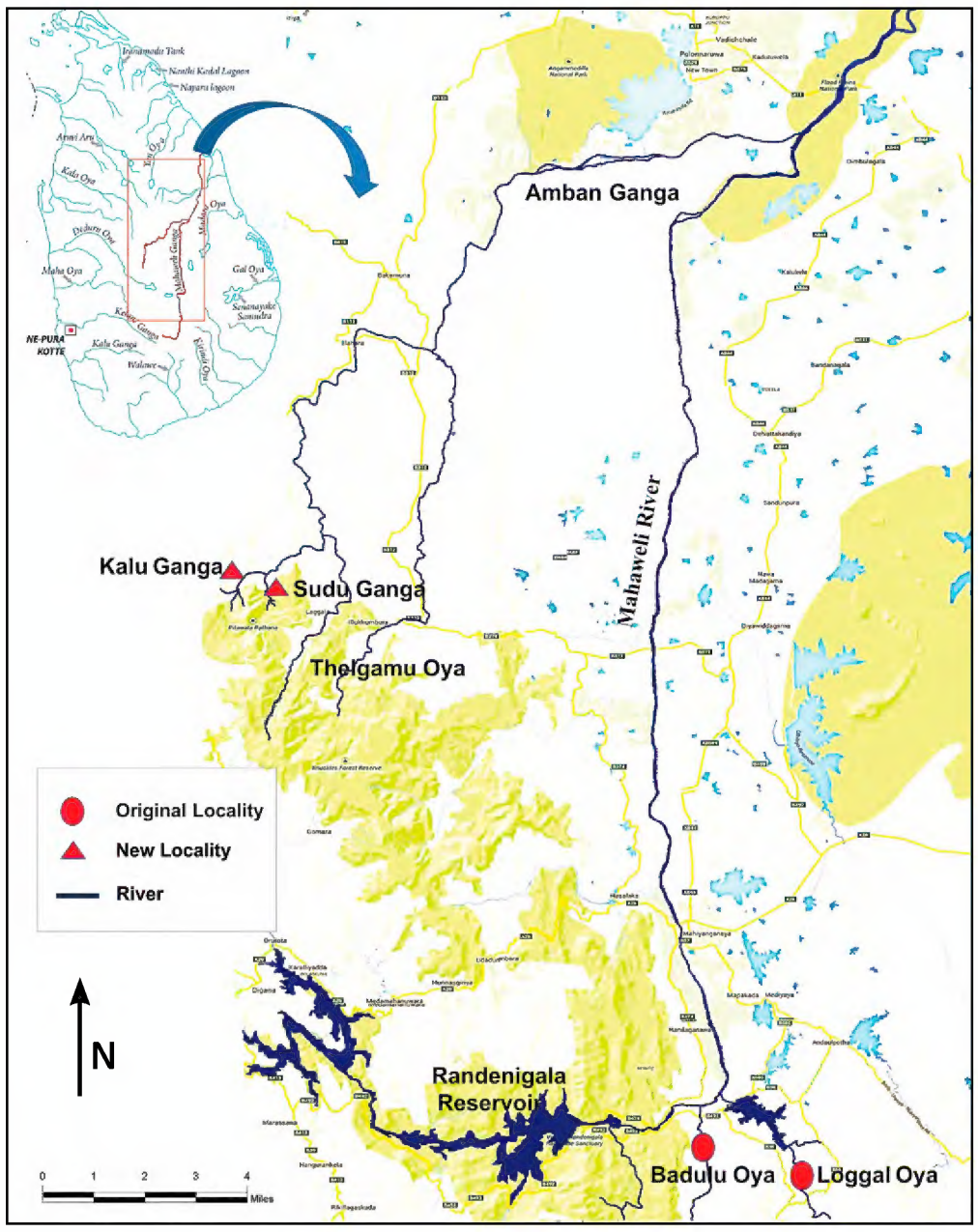

Figure 1. A map illustrating the type locality and the new localities (shown with red circles) of Systomus martenstyni in the downstream of the Mahaweli River. Source: adapted from the GIS database, Department of Geography, University of Peradeniya.

Two isolated populations of *S. martenstyni* were recorded at Loggal Oya (07°13′60″ N, 081°01′00″ E) and Badulu Oya (07°13′00″ N, 081°00′0″ E) during the study (Figure 1). A total of 195 individuals of *S. martenstyni* were recorded from both new localities with 84 from Loggal Oya and 111 from Badulu Oya (Average elevations 100 m and 110 m). Relative abundance of *S. martenstyni* in Loggal Oya and Badulu Oya were 3.8% and 6% respectively.

The collected species present a colour pattern consisting of a black blotch on caudal peduncle and six rows of black blotches along sides. The head and body were yellowish brown, darker on the back, yellowish or whitish in belly. All fins comprised of dark grey rays and hyaline membranes. The tips of pelvic, anal and caudal fins were orange-red; anterior rays of pelvic and anal fins were whitish and the tip of the dorsal fin was orange-red (Figure 2). Dorsal fin originates over ninth scale of lateral line with four simple rays and eight to nine branched rays. Anal fin with three simple and five branched rays, pectoral fin with one simple and 15 branched rays, pelvic fin with one simple and eight branched rays. Lateral line

Figure 2. Specimens of *Systomus martenstyni* collected from Loggal Oya.

Table 1. Morphometric data of *Systomus martenstyni* collected from Loggal Oya and Badulu Oya, downstream of Mahaweli River (n = 14).

	Loggal Oya				Badulu Oya			
Character	**Min**	**Max**	**Mean**	**%**	**Min**	**Max**	**Mean**	**%**
Total Length (TL)	102.91	104.23	103.82	-	105.69	109.13	107.32	-
Standard Length (SL)	79.81	80.73	80.38	-	81.94	82.65	82.55	-
Snout to Vent (SV)	57.99	58.21	58.05	72.2	57.81	58.43	57.87	70.1
Head Length (HL)	19.22	19.95	19.67	24.5	17.98	18.81	18.47	22.4
Predorsal Length (PDL)	37.97	38.51	38.14	47.4	39.12	39.54	39.3	47.6
Caudal Peduncle Depth (CPD)	10.14	10.68	10.51	13.1	10.84	11.32	11.1	13.4
Length of Caudal Fin (LC)	20.51	20.96	20.74	25.8	21.71	21.85	21.78	26.4
Body Depth (BD)	25.12	25.61	25.37	31.6	25.61	26.23	25.78	31.2
Orbit Diameter (OD)	5.97	6.31	6.04	7.51	6.98	7.41	7.28	8.82
Length of Dorsal Fin (LD)	16.43	16.98	16.87	21	17.31	17.47	17.41	30.1
Length of Anal Fin (LA)	11.12	11.47	11.25	14	12.23	12.57	12.51	15.2
Length of Pelvic Fin (Lpel)	12.23	12.47	12.51	15.6	12.04	12.16	12.11	14.7
Length of Pectoral Fin (Lpec)	14.31	14.59	14.52	18.1	15.05	15.26	15.18	26.2

was complete with 27–29 perforated scales on body, 10–11 pre dorsal scales, 3 scales between lateral line and pelvic fin origin giving the fin formula; D IV.8–9; A III.5; P I.15; V I,8; LL 27–29; L. lat 5½/3½. The maximum recorded size was 10.9 cm of standard length (SL). The morphometric data are given in Table 1. Principal Component Analysis (PCA) carried out for both Loggal Oya and Badulu Oya populations revealed that both these populations share the same morphometric characters (Figure 3).

Adult specimens were found in small groups with 3–5 individuals, inhabiting relatively deep (1–5 m) rock pools at the bottom of cascades, sheltering behind boulders in Loggal Oya (Figure 4). In contrast, specimens from Badulu Oya inhabited shallower water (<1 m) in boulder-strewn parts of streams with moderate flow (Figure 5). However, both these habitat types had no shade coverings. This species was found in sympatry with *Amblypharyngodon melettinus, Channa gachua, Garra ceylonensis, Rasbora dandia, Rasbora microcephalus, Labuca insularis, Puntius bimaculatus, Dawkinsia singhala, Devario malabaricus, Lepidocephalichthys thermalis, Glossogobius giuris* and *Labeo fisheri.*

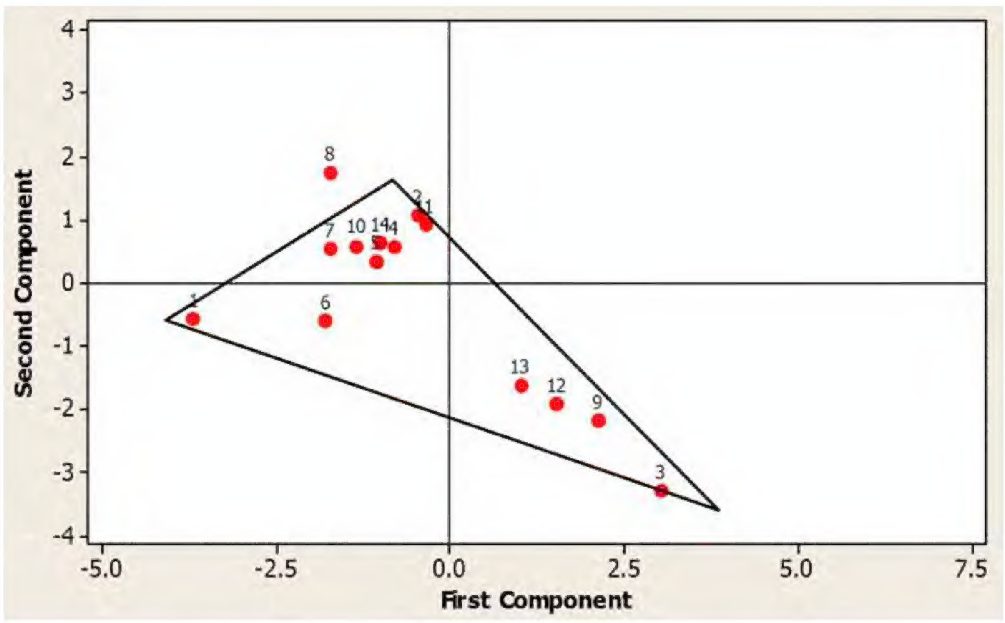

Figure 3. PCA analysis of 14 specimens obtained from Loggal Oya and Badulu Oya. Numbers 1–7 are specimens from Loggal Oya and numbers 8–14 are specimens from Badulu Oya.

Figure 4. Habitat of *Systomus martenstyni* in Loggal Oya, new locality.

Figure 5. Habitat of *Systomus martenstyni* in Badulu Oya, new locality.

Systomus martenstyni is distinguished from other sympatric barb species found in Sri Lanka by the colour pattern with a black blotch on caudal peduncle and six rows of black blotches along sides, scales along lateral line; 9–12 (modally 11) pre dorsal scales; two pairs of barbels, body depth 3.1–3.5 times in standard length (Pethiyagoda 1991). Morphological characters of all the observed specimens were similar to the morphological characters of the individuals of the same species recorded from the previously known localities (Pethiyagoda 1991). Previously, *S. martenstyni* was known to be confined to the elevations between about 150–500 m. However, the two new populations were recorded in elevations between 84–101 m. This is the lowest elevation at which *S. martenstyni* has been recorded so far. The two principal tributaries of Amban Ganaga, Kalu Ganga and Sudu Ganga, which are the previously known localities of *Systomus martenstyni,* originate on the Knuckles mountain range in the Central province of Sri Lanka (Figure 6). Loggal Oya and Badulu Oya originate on the Namunukula hills in the Uva province of Sri lanka (Athukorala 2012). Neither Kalu Ganga nor Sudu Ganga is interconnected with the two new localities of *S. martenstyni.* Amban Ganga meets the River Mahaweli in Manampitiya, North central province of Sri Lanka. The two new localities that we report on this paper are from the Uva province of Sri Lanka. Badulu Oya empties in to River Mahaweli approximately 94 km upstream from Manampitiya, where Amban Ganga connects with Mahaweli, and Loggal Oya empties in to river Mahaweli 91 km upstream from Manampitiya (Figure 1). Therefore, we can assume that the two new populations we recorded are independent and are isolated from the Amban Ganga basin.

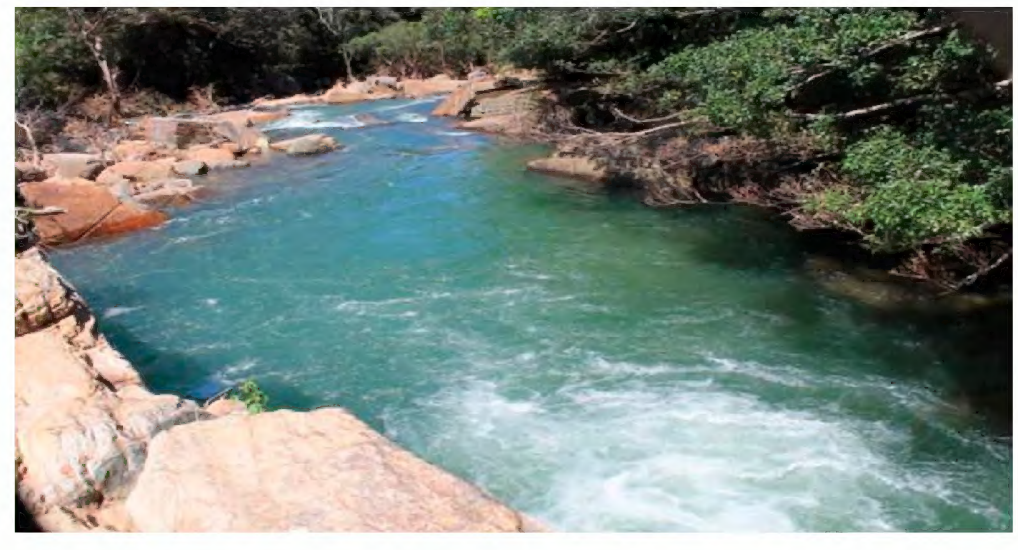

Figure 6. Type locality of *Systomus martenstyni* in the Amban River basin.

Figure 7. Sand mining in Loggal Oya.

The previous locality of *S. martenstyni*, the Amban Ganga basin has a relatively broad but highly discontinuous range (Pethiyagoda 1991). The discrete populations recorded from Amban Ganga basin are relatively small and the species is vulnerable and should be regularly monitored (Pethiyagoda 1991). National conservation status of the species was assessed as critically endangered and globally endangered (IUCN 2012). Due to the ongoing Moragahakanda and Kaluganga Development Project, which is the largest reservoir project under the Mahaweli Development Project, its habitat is highly threatened. The habitats occupied by *S. martenstyni* in the Amban River basin will be disturbed when the dams are constructed and the two reservoirs, Moragahakanda and Kaluganga, are built. Therefore, translocation of this species to the two new localities that we have recorded would be an option in order to conserve this endangered species. However, further ecological and molecular studies should be carried out prior to translocation.

Although it a positive story to record two new populations in two new localities, the populations are relatively small in size. At Badulu Oya and Loggal Oya the habitats preferred by *S. martenstyni* are also highly threatened due to human activities such as illegal sand mining (Figure 7), uncontrolled fishing in these tributaries using cast nets, dynamiting, fish poisoning with *Derris scandens* roots (a plant which is poisonous to fish). Furthermore, there is a mini-hydro development project proposed to convert the potential energy in the water of Badulu Oya and adjacent Loggal Oya to electrical energy by augmenting the water source of Minipe right bank canal (Athukorala 2012). It is essential that any type of development affecting these habitats should to be clearly assessed before granting approval. Implementation of species and habitat oriented conservation programs is needed to protect the existing small populations of this endangered cyprinid, *Systomus martenstyni*.

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